

**Computer Programs for Analysis of
Lobster (*Homarus americanus*)
Movements from Tag - Recapture Data**

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Canadian Manuscript Report of
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April 1983

COMPUTER PROGRAMS FOR ANALYSIS OF LOBSTER (HOMARUS AMERICANUS) MOVEMENTS
FROM TAG RELEASE-RECAPTURE DATA

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TABLE OF CONTENTS

	PAGE
ABSTRACT/RÉSUMÉ	iv
INTRODUCTION	1
ACKNOWLEDGMENTS	1
REFERENCES	1
INSTRUCTIONS FOR PROGRAM USE	2
SOURCE LISTING OF PROGRAM LOCSEL	6
SOURCE LISTING OF PROGRAM STATLOC	15
INPUT DATA EXAMPLE	18
OUTPUT DATA EXAMPLE	19

ABSTRACT

Campbell, A., S. E. Bellis, G. E. Fawkes, C. Haste. 1983. Computer programs for analysis of lobster (Homarus americanus) movements from tag release-recapture data. Can. MS Rep. Fish. Aquat. Sci. 1705: iv + 22 p.

Two computer programs are listed in FORTRAN IV with input instructions and samples of printout provided. The first program (LOCSEL) requires input on tag release-recapture information such as tag number, date, latitude and longitude, depth, size, sex, egg development stage, gear and/or person type retrieving tagged lobsters. Tag release-recapture data can be sorted by each of 23 possible categories (e.g. sex, depth of recapture, distance or direction moved, or growth). Output includes listing of all information for each tag sorted according to categories required in ascending order and statistical summaries (e.g. mean, SE, minimum and maximum) for depth ranges, straight-line distance and direction (degrees from north) moved, days at liberty, and growth between tag release and recapture.

The second program (STATLOC) requires input on straight-line distance and direction (degrees) traveled and days at liberty between tag release and recapture. The output provides statistical summary (e.g. mean, SE) on number of days at liberty and distance traveled, and direction such as the mean square dispersion coefficient, mean vector angle, and Rayleigh test for randomness about a circle of unit radius.

Although the programs are written for use on a HP3000 computer system, the programs can be adapted to other computer systems.

Key words: tagging, movements, computer program

RÉSUMÉ

Campbell, A., S. E. Bellis, G. E. Fawkes, C. Haste. 1983. Computer programs for analysis of lobster (Homarus americanus) movements from tag release-recapture data. Can. MS Rep. Fish. Aquat. Sci. 1705: iv + 22 p.

Deux programmes informatiques sont listés dans le FORTRAN IV avec des instructions d'entrée et des exemples de sortie sur imprimante. Le premier programme (LOCSEL) nécessite l'entrée d'informations sur la libération et la recapture après marquage comme le numéro de marquage, la date, la latitude et la longitude, la profondeur, la taille, le sexe, le stade de développement des oeufs, le type d'instrument et de personne ayant récupéré les homards marqués. Les données sur la libération et la recapture après marquage peuvent être classées dans 23 catégories (par exemple le sexe, la profondeur à laquelle la recapture a eu lieu, la distance parcourue ou la direction du déplacement, ou la croissance). Les résultats comprennent une liste imprimée, en ordre croissant, de toutes les informations obtenues sur chaque marquage classifié selon les catégories requises et des résumés statistiques (par exemple la moyenne, le SE, le minimum et le maximum) sur l'éventail des profondeurs, la distance parcourue en ligne droite et la direction du déplacement (en degrés à partir du nord), les jours de liberté et la croissance entre la libération après marquage et la recapture.

Le deuxième programme (STATLOC) exige l'entrée de données sur la distance parcourue en ligne droite, la direction du déplacement (en degrés) et les jours de liberté entre la libération après marquage et la recapture. Les résultats fournissent un résumé statistique (par exemple la moyenne, le SE) sur le nombre de jours de liberté, la distance parcourue et la direction du déplacement, comme le coefficient de dispersion quadratique moyen, l'angle vectoriel moyen et l'essai de Rayleigh sur le caractère aléatoire autour d'un cercle de rayon unitaire.

Bien que les programmes soient conçus pour être utilisés sur un système informatique HP 3000, ils peuvent s'adapter à d'autres systèmes informatiques.

INTRODUCTION

Large quantities of tag release-recapture data require the use of computer programs for rapid sorting and statistical summarization. Two computer programs are presented in this paper which are adapted to analyze lobster (*Homarus americanus*) movements from tag release-recapture information. The programs are applicable to other crustaceans in which the direction and distance traveled are calculated from release and recapture positions.

The first program (LOCSEL) requires input data for each individual on tag release and recapture information including tag number, date, latitude and longitude, depth, size (e.g. carapace length in mm), sex, egg development stage, gear and/or person type retrieving tag. The program can sort the input data on up to 23 different categories (e.g. sex, size and for distance moved) at a time and prints in ascending order all information for each tag according to the categories required. Statistical summaries are also provided. There is an option to create data files for use in the second program (STATLOC). LOCSEL calls two function subprograms (RDIFF1) to calculate the degree change from true north and distance (nautical miles or kilometers) traveled from latitude-longitude data and (DIFF2) to calculate the number of days at liberty between the tag release and recapture dates.

The second program (STATLOC) requires input on straight-line distance (e.g. nautical miles or kilometers) and direction (degrees from true north) traveled and days at liberty between tag release and recapture. This program is set up to receive a data file with distance, direction, and time at liberty information that has been created by the program LOCSEL. The output provides statistical summaries of the number of days at liberty and distance and direction traveled.

Also, for an evaluation of the directional components of movement, the following test statistics are computed according to Jones (1959) and Salla and Flowers (1968):

Mean square
dispersion
coefficient
(km²/day)

$$a^2 = \frac{1}{n} \left[\sum \frac{r^2}{t} - \frac{(\sum r \cos \theta)^2}{\sum t} \right]$$

North-south
directional
component
(km/day)

$$V = \frac{\sum r \cos \theta}{\sum t}$$

East-west
directional
component
(km/day)

$$V' = \frac{\sum r \sin \theta}{\sum t}$$

Mean vector
angle

$$\theta = \arctan \left[\frac{\sum r \sin \theta}{\sum r \cos \theta} \right]$$

Rayleigh test $Z = R^2/n$

where n = number of individual tag returns;

$$R = \sqrt{(\sum r \sin \theta)^2 + (\sum r \cos \theta)^2}$$

r = apparent "straight line" distance traveled (km) from release to recapture point;

θ = direction of travel from an arbitrary reference point;

t = time (days) from release to recapture.

All angles (θ) are presented as deviations of true north. The Rayleigh test is a statistical test for randomness or uniform distribution of points about a circle of unit radius (Batschalet 1965). The mean square dispersion coefficient is dependent on both the rate of travel and mean distance traveled and is a measure of undirected or random movement based on physical theories of diffusion and heat conduction (Skellam 1951; Jones 1959). The parameters V and V' indicate the mean rate of directed (non-random) movement of a group of tagged lobsters in the north-south and east-west direction, respectively. Care should be used in interpreting the summary directional statistics and the user should be aware of the assumptions involved (Batschalet 1965).

Although the two programs are written in FORTRAN IV for use on an HP3000 computer system, the programs can be adapted to other computer systems.

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2
INSTRUCTIONS FOR PROGRAM USE

LOCSEL PROGRAM

PROGRAM ACCEPTS "081" DATA RECORDS.

FORMAT OF INPUT DATA RECORD "081" IS:

FIELD	NO. OF CHARACTERS	FORMAT	ITEM
1-3	3	I3	STATION
4-8	5	I5	TAG NO.
9	1	I1	TAG TYPE
10-15	6	3I2	DATE RELEASE,D/MO/YR.
16-19	4	2I2	LATITUDE AT RELEASE,DEG.,MIN.
20-23	4	2I2	LONGITUDE AT RELEASE,DEG.,MIN.
24-26	3	I3	SIZE AT RELEASE,CARAPACE LENGTH,MM.
27	1	I1	SEX AT RELEASE,1=MALE,2=FEMALE, 3=BERRIED
28-33	6	3I2	DATE RECAPTURED,D/MO/YR.
34-37	4	2I2	LATITUDE AT RECAPTURE,DEG.,MIN.
38-41	4	2I2	LONGITUDE AT RECAPTURE,DEG.,MIN.
42	1	I1	RELEASE=1
43	1	I1	RECAPTURE=1
44-47	4	4X	SKIP
48	1	I1	EGG STAGE 1=NEW EGG,2=OLD EGG,3=REMNANTS
49-52	4	4X	SKIP
53	1	I1	FOUND,1=FISHERMAN,2=PLANT
54	1	I1	GEAR TYPE,1=INSHORE,2=OFFSHORE, 3=SCALLOP DRAG
55-57	3	I3	SIZE AT RECAPTURE,CARAPACE LENGTH,MM.
58	1	I1	SEX AT RECAPTURE,1=MALE,2=FEMALE, 3=BERRIED
59	1	1X	SKIP
60-62	3	I3	DEPTH AT RELEASE
63-65	3	I3	DEPTH AT RECAPTURE
66-77	12	12X	SKIP
78-80	3	A3	"081" RECORD ID.

USE THE FOLLOWING EXAMPLE TO SET UP STREAM FILE:

```
!JOB INV.GROUP
!PURGE TAGD80
!PURGE LOC1
!BUILD LOC1;REC=-80,,F,ASCII;DISC=5000
!FILE FTN01=TAGD80,NEW;SAVE;DISC=1000,16,1;REC=-27,,F,ASCII
!FILE FTN02=LOC1,OLD
!FILE FTN07=DATAFILE,OLD
!FILE FTN08=MALE081,OLD
!FILE FTN09=FEM081,OLD
!RUN LOCSEL
```

CONTROL RECORDS(3)
!EQJ

CONTROL RECORDS (FREE FORMAT)

THERE ARE THREE CONTROL RECORDS:

1. THE FIRST CONTROL RECORD HAS TWO FIELDS:

OPT1,OPT2

SUPPLY THE OPTION VALUE-IF OPT1=1,THE DATA FILE LOC1 WILL BE PRODUCED
FOR THE USE OF STATLOC PROGRAM.

IF OPT1=2,IT DOES NOT.

IF OPT2=1,CHANGE NAUTICAL MILES TO KILOMETERS.

IF OPT2 IS ANY OTHER NUMBER THAN 1,THEN VALUES ARE IN NAUTICAL MILES.

2. THE SECOND CONTROL RECORD HAS ONE FIELD:

TITLE(MAX.80 CHARACTERS)

3. THE THIRD CONTROL RECORD HAS ELEVEN FIELDS:

FROM DATE, TO DATE, GROWTH LIMIT, BASE TIME, INPUT FILE NUMBER, NUMBER OF KEYS, KEYS, NUMBER OF EXCLUSIONS, EXCLUSIONS, EXCLUSIONS, EXCLUSIONS.

FROM DATE-ONLY DATA RECAPTURED AFTER THIS DATE WILL BE PROCESSED.
SEE "TO DATE" ALSO. YR/MO/D IN FORMAT 312

TO DATE-ONLY DATA RECAPTURED ON OR BEFORE THIS DATE WILL BE PROCESSED. SEE "FROM DATE" ALSO. YR/MO/D IN FORMAT 312

GROWTH LIMIT-WOULD EXCLUDE ANY DATA WITH A SIZE DIFFERENCE LESS THAN THIS GIVEN VALUE. E.G IF THE VALUE GIVEN WAS 5 (I.E. 2,3,4,2.5) WOULD BE EXCLUDED FROM SUMMARY TABLE BUT IS SHOWN IN OUTPUT WITH ASTERISK AT FAR RIGHT.

BASE TIME-THIS VALUE IS EXPRESSED IN DAYS. WOULD EXCLUDE ANY DATA WHICH HAD BEEN OUT LESS THAN THE GIVEN NUMBER OF DAYS. E.G. IF THE VALUE WAS 50, ANYTHING LESS THAN 50 DAYS, (I.E. 25,30,10) WOULD BE EXCLUDED FROM THE LISTING AND DATA SUMMARY TABLES.

INPUT FILE NUMBER=7

NUMBER OF KEYS-THE NUMBER OF FIELDS TO BE SORTED. DEFAULT IS 1.

KEYS-A KEY NUMBER TO DESCRIBE WHICH FIELDS ARE TO BE SORTED. THE FOLLOWING IS A LIST OF KEY NUMBERS AND THEIR DESCRIPTIONS:

- 1-TAG NUMBER
- 2-DATE RELEASED
- 3-LONGITUDE AND LATITUDE(RELEASED)
- 4-DEPTH AT RELEASE
- 5-SIZE AT RELEASE
- 6-SEX AT RELEASE
- 7-DATE RECAPTURED
- 8-LONGITUDE AND LATITUDE(RECAPTURED)
- 9-DEPTH AT RECAPTURE
- 10-SIZE AT RECAPTURE
- 11-SEX AT RECAPTURE
- 12-GROWTH
- 13-PERCENTAGE GROWTH
- 14-CHANGE IN DEPTH
- 15-DISTANCE MOVED
- 16-DEGREES
- 17-DAYS OUT
- 18-TAG TYPE
- 19-FOUND
- 20-GEAR
- 21-FLAG
- 22-STATION
- 23-EGG STAGE

DEFAULT IS 1, SORTED BY TAG NUMBER IN ASCENDING ORDER.

NUMBER OF EXCLUSIONS-THE NUMBER OF FIELDS HAVING EXCLUSIONS.
THIS VALUE CAN BE SPECIFIED AS "0" FOR NO EXCLUSIONS.

EXCLUSIONS-ANY NUMBER OF GROUPS CONTAINING THREE NUMBERS EACH FIRST BEING A KEY NUMBER TO DESCRIBE THE FIELD HAVING EXCLUSIONS; THE SECOND AND THIRD GIVING THE RANGE OF VALUES TO BE INCLUDED IN THE FIELD. IF THE NUMBER OF EXCLUSIONS IS 0, THIS FIELD WILL BE IGNORED. MAXIMUM EXCLUSIONS IS THREE.

EXAMPLE OF CONTROL RECORDS:

1,1
AREA A, 1977-78 RELEASES
000000, 999999, -1, 0, 7, 1, 15, 1, 5, 95, 999

EXPLANATION OF OUTPUT OF LOCSEL

PROGRAM PRODUCES A TABLE LISTING INFORMATION READ FROM DATA FILE; DIFFERENCES IN SIZE, DEPTH, LATITUDE, AND DEGREES; % CHANGE IN GROWTH AND THE NUMBER OF DAYS OUT FOR EACH LOBSTER BETWEEN RELEASE AND RECAPTURE.

A SUMMARY IS PRODUCED LISTING RELEASES, RECAPTURES, AND % OF RELEASES WHICH WERE RECAPTURED FOR MALES, FEMALES, BERRIED, TOTAL FEMALES AND TOTAL. A TABLE LISTING MEAN, S.E., S.D., MIN., MAX., RANGE, NUM., AND SUM FOR DEPTH CHANGE, DISTANCE MOVED, DAYS RELEASED, GROWTH AT RECAPTURE, REL. SIZE AT RECAPTURE, RELEASE DEPTH, AND RECAPTURE DEPTH.

INPUT RELEASE INFORMATION WITHOUT RECAPTURE DATA CAN ALSO BE USED. THE PROGRAM WILL IGNORE RELEASE INFORMATION ONLY WHERE BOTH RELEASE AND RECAPTURE DATA SUMMARIES CALCULATIONS ARE REQUIRED FOR SUMMARY INFORMATION.

IN THE OUTPUT TABLE OF DATA LISTING THE HEADING CATEGORIES ARE:

REL S/E=RELEASE SEX (S) AND EGG STAGE (E):

TT=TAG TYPE;

F=THE FOUND BY CATEGORY:

G= GEAR TYPE:

CODES=RECORD TYPE:

E= RELEASE CODE. IF THERE IS AN ASTERISK BESIDE THIS COLUMN, THE DATA IN THE ROW ARE EXCLUDED FROM THE SUMMARY TABLES BECAUSE SOMETHING IS WRONG WITH THE RELEASE-RECAPTURE DATA, E.G. NO SEX GIVEN AT RELEASE.

A NEGATIVE VALUE UNDER "GTH MM" AND "GRTH %" (PERCENT GROWTH) INDICATES THAT THE RECOVERY LENGTH (REC SZ) IS PROBABLY MISSING. A NEGATIVE VALUE UNDER DEPTH CHANGE (DEP CHG) COULD INDICATE THAT THE RECOVERY DEPTH (REC DEP) IS MISSING. EXAMPLE INPUT' OUTPUT AFTER PROGRAM LISTING.

STATLOC PROGRAM

INPUT

INITIAL DATA MUST BE RUN THROUGH THE LOCSEL PROGRAM WHICH CREATES A DATA FILE "LOC1". THE MAIN INPUT DATA REQUIRES STRAIGHT LINE DISTANCE MOVED(KM OR NAUT. MILES), DIRECTION MOVED, (IN DEGREES FROM TRUE NORTH) AND DAYS OUT BETWEEN RELEASE AND RECAPTURE.

FORMAT OF INPUT DATA RECORD IS:

FIELD	NO. OF CHARACTERS	FORMAT	ITEM
1-5	5	I5	TAG NUMBER
6-7	2		SPACE
8-12	5	F5.1	DISTANCE TRAVELLED
11-13	2		SPACE
14-18	5	F5.1	DIRECTION IN DEGREES
19-20	2		SPACE
21-24	4	I4	DAYS OUT BETWEEN RELEASE AND RECAPTURE
25-26	2		SPACE
27-28	2	I2	FLAG FOR KM (1) OR NAUT. MILES (2)

USE THE FOLLOWING EXAMPLE TO SET UP STREAM FILE TO RUN PROGRAM.

```
!JOB INV.GROUP
!FILE FTN02=LOC1,OLD
!RUN STATLOC
  TITLE RECORD
!EOJ
```

TO USE INTERACTIVELY:

```
:FILE FTN02=LOC1,OLD
:FILE FTN06;DEV=LP(THIS FILE DECLARATION SENDS THE OUTPUT TO THE
  LINEPRINTER. IF THE OUTPUT IS REQUESTED ON THE
  TERMINAL BEING USED,LEAVE THIS OUT.)
:RUN STATLOC
  CURSOR WILL PROMPT YOU TO TYPE IN TITLE,AND THEN PRESS
  CARRIAGE RETURN.
(IF MORE THAN ONE RUN IS TO BE DONE INTERACTIVELY,THE FILES ONLY
HAVE TO BE DECLARED ONCE. TO ERASE THE PREVIOUS FILE DECLARATIONS
TYPE "RESET 0".
```

EXPLANATION OF OUTPUT OF STATLOC.

PROGRAM USES THE DATA FILE LOC1(OBTAINED FROM RUNNING LOCSEL FIRST) TO PRODUCE VALUES FOR THE MEAN SQUARE DISPERSIONS COEFFICIENT, NORTH-SOUTH DIRECTIONAL COMPONENT,EAST-WEST DIRECTIONAL COMPONENT, MEAN VECTOR ANGLE,RAYLEIGH TEST,RAYLEIGH TEST STATISTICS,AND THE COMPONENT OF THE RAYLEIGH TEST IN THE DIRECTION OF THE THEORETICAL ANGLE,THE NUMBER OF INDIVIDUALS,SUM,MINIMUM VALUE,MAXIMUM VALUE, RANGE,MEAN,STANDARD DEVIATION,AND STANDARD ERROR ARE ALSO GIVEN FOR DAYS OUT AND DISTANCES MOVED. EXAMPLE INPUT AND OUTPUT FOLLOWS PROGRAM LISTINGS.

C SOURCE LISTING OF PROGRAM LOCSEL.

C PROGRAM LOCSEL

C SAVED IN EDITOR AS QLOCSEL

C MODIFIED TO PRINT ONLY RECAPTURE INFO WHEN SAME LOBSTER

C RECAPTURED. ALSO TO REMOVE UNKNOWN VALUES FOR DIST.,DEG.,TIME

C JAN 20/83--G.FAWKES

C FIELD DECLARATORS

INTEGER*4 TAG,ITM,IDIFF2,TABLE(5,8,2),NXTR,RC,FDTE,DATE1

INTEGER*4 RLT,RCT,RLM,RCM,RLF,RCF,RLB,RCB,RECS,TDTE,IDTE

INTEGER*4 RCFB,TLFLB

REAL DGS,FIELD,V(11),DST,RDIFF1,E(3,23)

INTEGER DRLD,DRLM,DRLY,LT1D,LT1M,LN1D,LN1M,LT2D,LT2M,LN2D,LN2M

INTEGER DRCD,DRCM,DRCY,TYP,SZ1,SZ2,SX1,SX2,FND,GR,DP1,DP2,C1,OPT1

LOGICAL LR(6),LAOP,LPOP,LK(99),LREC(65),FAIL,SUSP,LC(40),FLAG

INTEGER DATA4,OPT2

REAL DATA2,DATA3

INTEGER AOP,POP,KY(99),FNUM,KYS(23),KFD1(2,23)

CHARACTER FLG*1,TITLE*80,DATEL*27,CMD*80,REC*12,C2*3,FL*18

CHARACTER CREC*129

CHARACTER ST1*8(5),ST2*14(8),REC1*129,TF*9,KFD*5(23),SRTHME*17

CHARACTER TREC*6

CHARACTER ST3*14,ST4*14

EQUIVALENCE (REC,LR),(LPOP,POP),(LAOP,AOP),(LK,KY),(LREC,REC1)

EQUIVALENCE (LC,CMD)

SYSTEM INTRINSIC COMMAND,FOPEN,FCLOSE,FREADDIR,FWRITEDIR

SYSTEM INTRINSIC FGETINFO

SYSTEM INTRINSIC DBINARY,CREATE,ACTIVATE,FREAD,FWRITE

FOR A DESCRIPTION OF SYSTEM INTRINSICS REFER TO:

HP 3000

MPE INTRINSICS

REFERENCE MANUAL

PART NO 30000-90010

AVAILABLE FROM:

HEWLETT-PACKARD COMPANY

COMPUTER SYSTEM DIVISION

MPE DOCUMENTATION

19447 PRUNERIDGE AVENUE

CUPERTINO,CAL. 95014

DATA ST1/"MALE ", "FEMALE ", "BERRIED ", "TOTAL ", "TOT FEM "

DATA ST2/"DEPTH CHANGE ", "DISTANCE MOVED", "DAYS RELEASED ",

1 "GRTH AT RECAP ", "REL SZ OF REC", "RELEASE DEPTH ", "RECAPTURE DEP

2.", "RELEASE SIZE "

DATA ST3/"(NAUT. MILES)"/,ST4/"(KILOMETERS)"/

DATA KFD/"02,05","09,08","19,09","29,03","33,03","38,01",

1"43,08","53,09","63,03","67,03","72,01","73,05","78,07",

2"86,05","92,05","98,05","105,4","111,1","114,1","116,1","127,1",

3"118,3","40,01"/

DATA KFD1/2,5,9,8,19,9,29,3,33,3,38,1,43,8,53,9,63,3,67,3,

172,1,73,5,78,7,86,5,92,5,98,5,105,4,111,1,114,1,116,1,127,1,118,3,

240,1/

C PROGRAM INITIALIZATION

CALL UNITCONTROL(8,1)

CALL UNITCONTROL(9,1)

CALL UNITCONTROL(8,8)

CALL UNITCONTROL(9,8)

RLT=0

RLM=0

RLF=0

```

RLB=0
RCM=0
RCF=0
RCB=0
RCFCB=0
TLFLB=0
RCT=0
TREC[1:5]=" "
AOP=$405
POP=$4
WRITE(CMD,7000)
7000 FORMAT("PURGE LOCWRK",$15C)
CALL COMMAND(CMD,IERR,IPRM)
WRITE(CMD,7001)
7001 FORMAT("BUILD LOCWRK;DISC=6000;REC=65,1,F,ASCII",$15C)
CALL COMMAND(CMD,IERR,IPRM)
FL="LOCWRK.PUB.GROUP "
ILW=POPEN(FL,$3L,$505L,65,,,1,1)
IF(.CC.) 901,2,901
901 CALL PRINTFILEINFO(ILW)
STOP 1
2 IFL=POPEN(,LPOP,LAOP,6,"002",,,1,1,50000J,32,1)
IF(.CC.) 900,1,900
900 CALL PRINTFILEINFO(IFL)
STOP
1 CALL DATELINE(DATEL)
C READ CONTROL CARDS.THE FIRST CARD CONTAINS THE OPTION. THE
C SECOND CONTAINS THE TITLE. THE THIRD CONTAINS THE RANGE OF
C DATES TO BE PROCESSED,GROWTH LIMIT,BASE TIME IN DAYS,DATA
C INPUT FILE NUMBER,NUMBER OF FIELDS TO BE SORTED,THE FIELDS TO
C BE SORTED,THE NUMBER OF FIELDS TO HAVE EXCLUSIONS, AND THE
C FIELD TO BE SORTED WITH THE RANGE OF VALUES TO BE EXCLUDED.
C
C CONTROL RECORDS ARE FREE FORMAT.
C
READ(5,*)opt1,opt2
READ(5,*) TITLE
READ(5,*)FDTE,TDTE,GL,IBT,INF,NKY,(KYS(I),I=1,NKY),NEX,((E(I,J),
1I=1,3),J=1,NEX)
IF(NKY.NE.0) GOTO 10
NKY=1
KYS(1)=1
C READ DATA FROM CARDS.
10 READ(INF,5000,END=61)C1,TAG,TYP,DRLD,DRLM,DRLY,LT1D,LT1M,LN1D,
1LN1M, SZ1,SX1,DRCD,DRCM,DRCY,LT2D,LT2M,LN2D,LN2M,IRL,IRC,IEG,FND,
2GR,sz2,SX2,DP1,DP2,C2
5000 FORMAT(I3,I5,I1,7I2,I3,I1,7I2,2I1,4X,A1,4X,2I1,I3,I1,1X,2I3,
112X,A3)
C
C DISTANCE TRAVELLED AND DEGREES.
C
DST=RDIF1(LT1D,LT1M,LN1D,LN1M,LT2D,LT2M,LN2D,LN2M,DGS)
C CHANGE NAUT. MILES TO KM.
IF(OPT2.EQ.1) DST=DST*1.8532
ITM=IDIFF2(DRLD,DRLM,DRLY,DRCD,DRCM,DRCY)
IF(ITM.LT.IBT) GOTO 10
IDTE=DRCY
IDTE=IDTE*10000+DRCM*100+DRCD
IF(IDTE.LT.FDTE.OR.IDTE.GT.TDTE) GOTO 10
DEPTH=FLOAT(DP2-DP1)

```

```

      FLG=" "
      GRTH=FLOAT(SZ2-SZ1)
      PCGTH=0
      IF(SZ1.NE.0) PCGTH=GRTH/FLOAT(SZ1)*100.0
C
C      CHECK TO SEE WHETHER ERRORS WERE MADE IN DETERMINING THE SEX,
C      EITHER BEFORE RELEASE OR AFTER RECAPTURE.
C
      IF((SX1.EQ.1.AND.SX2.GT.1).OR.(SX2.EQ.1.AND.SX1.NE.1)) FLG="**"
      IF((SX1.LT.1.OR.SX1.GT.3)) FLG="**"
      IF(ITM.LT.0) FLG="**"
      WRITE(REC1,6001) TAG,DRLY,DRLM,DRLD,LT1D,LT1M,LN1D,LN1M,DP1,SZ1,
1SX1,LEG,DRCY,DRCM,DRCD,LT2D,LT2M,LN2D,LN2M,DP2,SZ2,SX2,GRTH,PCGTH,
2DEPTH,DST,DGS,ITM,TYP,FND,GR,C1,C2,FLG,IRC
      IF(NEX.LT.1) GOTO 7
      DO 6 I=1,NEX
      TF=" "
      TF=(9-KFD1(2,IFIX(E(1,I)))+1:KFD1(2,IFIX(E(1,I))))=
1REC1(KFD1(1,IFIX(E(1,I))):KFD1(2,IFIX(E(1,I))))
      VAL=RUNUM(TF)
      IF(E(2,I).EQ.0.0.AND.E(3,I).EQ.0.0.AND.VAL.LE.E(2,I)) GOTO 10
      IF(E(2,I).EQ.0.0.AND.E(3,I).EQ.0.0) GOTO 6
      IF(VAL.LT.E(2,I).OR.VAL.GT.E(3,I)) GOTO 10
6 CONTINUE
7 RLT=RLT+1
C
C      TOTAL THE NUMBER OF MALES AND FEMALES FOR RELEASES AND
C      RECAPTURES.
C
      IF(SX1.EQ.1) RLM=RLM+1
      IF(SX1.EQ.2) RLF=RLF+1
      IF(SX1.EQ.3) RLB=RLB+1
      IF(IRC.EQ.0) GOTO 3
      RCT=RCT+1
      IF(SX2.EQ.1) RCM=RCM+1
      IF(SX2.EQ.2) RCF=RCF+1
      IF(SX2.EQ.3) RCB=RCB+1
      IF(SX2.EQ.0.AND.SX1.EQ.1) RCM=RCM+1
      IF(SX2.EQ.0.AND.SX1.EQ.2) RCF=RCF+1
      IF(SX2.EQ.0.AND.SX1.EQ.3) RCB=RCB+1
C
C      FILE FTN08 IS THE MALE PLOTTING OUTPUT
C      FILE FTN09 IS THE FEMALE + BERRIED PLOTTING OUTPUT
C      THEY CONTAIN: RELEASE SIZE, DISTANCE MOVED, TIME OUT (IN DAYS)
C
      IF(SX1.LT.1.OR.SX1.GT.4) GOTO 3
      IF(IRC.NE.1) GOTO 3
      IF(LT1D.LT.1.OR.LN1D.LT.1.OR.LT2D.LT.1.OR.LN2D.LT.1) GOTO 3
      IF(DRLY.LT.1.OR.DRCY.LT.1) GOTO 3
      IF(SZ1.LT.20.OR.SZ1.GT.300) GOTO 3
      IF(SX1.NE.1) GOTO 200
      WRITE(8,201) SZ1,DST,ITM
201 FORMAT(F4.0,F8.2,F5.0)
      GOTO 3
200 WRITE(9,201) SZ1,DST,ITM
      3 CALL FWRITE(ILW,LREC,65,$OL)
      IF(.CC.) 90,10,90
90 CALL PRINTFILEINFO(ILW)
      STOP 20
61 WRITE(CMD,7002)

```

```

7002 FORMAT("PURGE STDIN",%15C)
CALL COMMAND(CMD,IERR,IPRM)
CALL UNITCONTROL(8,8)
CALL UNITCONTROL(9,8)
WRITE(CMD,7010)
7010 FORMAT("PURGE LOCWRK1",%15C)
CALL COMMAND(CMD,IERR,IPRM)
WRITE(CMD,7003)
7003 FORMAT("BUILD STDIN;DISC=10;REC=40,1,F,ASCII",%15C)
CALL COMMAND(CMD,IERR,IPRM)
WRITE(CMD,7009)
7009 FORMAT("FILE STDIN=STDIN.PUB.GROUP,OLD",%15C)
CALL COMMAND(CMD,IERR,IPRM)
FL="STDIN.PUB.GROUP "
ISC=FOPEN(FL,%3L,%505L,40,,,1,1)
IF(.CC.) 902,4,902
902 CALL PRINTFILEINFO(ISC)
STOP 3
4 CONTINUE
WRITE(CMD,7006)
7006 FORMAT("INPUT LOCWRK")
CALL FWRITE(ISC,LC,40,%0L)
IF(.CC.) 903,5,903
903 CALL PRINTFILEINFO(ISC)
STOP 4
5 CONTINUE
CMD[1:1]=" "
CMD[2:79]=CMD[1:79]
CMD[1:5]="KEY "
DO 62 I=1,NKY
CMD[I*6:5]=KFD(KYS(I))
IF(I.GE.NKY) GOTO 62
CMD[I*6+5:1]=";"
62 CONTINUE
CALL FWRITE(ISC,LC,40,%0L)
WRITE(CMD,7007)
7007 FORMAT("OUTPUT LOCWRK1")
CALL FWRITE(ISC,LC,40,%0L)
WRITE(CMD,7008)
7008 FORMAT("END")
CALL FWRITE(ISC,LC,40,%0L)
CALL FCLOSE(ILW,1,0)
CALL FCLOSE(ISC,1,0)
SRTNME="SUPRSORT.PUB.SYS "
SUSP=%2L
FLAG=%1L
CALL CREATE(SRTNME,,IPW,,FLAG)
IF(.CC.) 63,64,64
63 STOP 96
64 CALL ACTIVATE(IPW,SUSP)
WRITE(CMD,7004)
7004 FORMAT("PURGE LOCWRK",%15C)
CALL COMMAND(CMD,IERR,IPRM)
WRITE(CMD,7005)
7005 FORMAT("PURGE STDIN",%15C)
CALL COMMAND(CMD,IERR,IPRM)
FL="LOCWRK1.PUB.GROUP "
ILW=FOPEN(FL,%3L,%505L,65,,,1,1)
IF(.CC.) 904,60,904
904 CALL PRINTFILEINFO(ILW)

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```

      STOP 5
60 ICNT=FREAD(ILW,LREC,65)
   IF(.CC.) 66,67,500
66 CALL PRINTFILEINFO(ILW)
      STOP 30
67 IF(LNS.GT.0) GOTO 20

C
C   DATA TABLE WILL BE PRINTED WITH FOLLOWING LABELS.
C
      WRITE(6,6000) TITLE,DATL
6000 FORMAT("1",A80,18X,A27,/,/,2X,"TAG      DATE      REL REL REL ",
1"REL REL      DATE      REC REC REC REC REC GTH  GRTH  DEP  DIST
2 TRUE  DAYS  T  F  G  CODES  E",/,3X,"#      RELEASED      LAT  LOW
3DEP  SIZ  S/E  RECAPTURED  LAT  LOW  DEP  SIZ  SEX  MM      $",3X,"CHG
4MOVED  DIRC  OUT  T")
   IF(OPT2-1)7050,7051,7050
7050 WRITE(6,7080)
7080 FORMAT(91X,"N.MI.'/)
      GO TO 7090
7051 WRITE(6,7081)
7081 FORMAT(91X,"KM.'/)
7090 LNS=74
      20 IF(REC1[2:5].NE.TREC[2:5]) GO TO 7060
         CREC[1:129]=REC1[1:129]
         WRITE(6,7061)CREC[43:86]
         GO TO 7062
7060 WRITE(6,6101) REC1
         TREC[2:5]=REC1[2:5]
7061 FORMAT(42X,A86)
7062 IF(OPT1.NE.1)GO TO 100
         READ(REC1,102)DATA1,IYR,IMO,IDY,LAT1,LAT2,DATA2,DATA3,DATA4
102  FORMAT(1X,I5,36X,I2,2(1X,I2),2X,I2,3X,I2,32X,F5.1,1X,F5.1,2X,I4)
         IF(IMO.EQ.0)DATA4=-99
         IF(LAT1.EQ.0.OR.LAT2.EQ.0)DATA2=999
         IF(LAT1.EQ.0.OR.LAT2.EQ.0)DATA3=999
         WRITE(2,101)DATA1,DATA2,DATA3,DATA4,OPT2
101  FORMAT(I5,2X,F5.1,2X,F5.1,2X,I4,2X,I2)
100  CONTINUE
6101 FORMAT(A128)
6001 FORMAT(1X,I5,2X,I2,"/",I2,"/",I2,2X,2I2,1X,2I2,1X,I3,1X,I3,2X,
1I1,1X,A1,2X,I2,"/",I2,"/",I2,2X,2I2,1X,2I2,1X,I3,1X,I3,2X,I1,F5.0,
2F7.2,1X,F5.0,1X,F5.1,1X,F5.1,2X,I4,2X,I1,2X,I1,1X,I1,1X,I3,"/",A3,
32X,A1,I1)
         LNS=LNS-1
         READ(REC1,6102)TAG,DRLY,LT1D,LT1M,LN1D,LN1M,DP1,SZ1, SX1,DRCY,DRCM,
1DRCD,LT2D,LT2M,LN2D,LN2M,DP2,SZ2, SX2,GRTH,DEPTH,DST,ITM,FLG,IRC
6102 FORMAT(1X,I5,2X,I2,8X,2I2,1X,2I2,1X,I3,1X,I3,2X,I1,4X,I2,
11X,I2,1X,I2,2X,2I2,1X,2I2,1X,I3,1X,I3,2X,I1,F5.0,8X,F5.0,
21X,F5.1,8X,I4,18X,A1,I1)
         WRITE(1,1900) TAG,LT1D,LT1M,LN1D,LN1M,DRCD,DRCM,DRCY,
1LT2D,LT2M,LN2D,LN2M
1900 FORMAT(I5,11I2)
         IF(FLG.NE." ") GOTO 60

C
C   SEPARATE THE FIELD BY MALE, FEMALE, BERRIED, AND TOTAL.
C
      DO 25 I=1,5
      IF(I.EQ.1.AND.SX1.EQ.1) GOTO 50
      IF(I.EQ.1.AND.SX1.EQ.2) I=2
      IF(I.EQ.1.AND.SX1.EQ.3)I=3

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      IF(I.EQ.2.AND.SX1.EQ.1) I=4
      IF(I.EQ.3.AND.SX1.EQ.2) I=4
      IF(I.EQ.4.AND.SX1.EQ.3) I=4
      IF(I.EQ.5.AND.SX1.EQ.1) GO TO 25
      IF(I.EQ.5.AND.SX1.EQ.2) I=5
      IF(I.EQ.5.AND.SX1.EQ.3) I=5
50  CONTINUE
C
C      USE CONTROL INFORMATION TO EXCLUDE UNNECESSARY DATA FROM
C      SPECIFIED FIELDS.
C
      DO 24 J=1,8
      GOTO (41,42,43,44,45,46,47,48),J
28  IF(TABLE(I,J,1).EQ.0) GOTO 30
      CALL FREADDIR(IFL,LR,6,TABLE(I,J,2))
      IF(.CC.) 905,26,905
905  CALL PRINTFILEINFO(IFL)
      STOP 70
26  READ(REC,1001) FIELD1,NITR
      RC=RC+1
      WRITE(REC,1001) FIELD1,RC
      CALL FWRITEDIR(IFL,LR,6,TABLE(I,J,2))
      IF(.CC.) 906,27,906
906  CALL PRINTFILEINFO(IFL)
      STOP 71
27  WRITE(REC,1001) FIELD,0
1001 FORMAT(F6.1,I6)
      CALL FWRITEDIR(IFL,LR,6,RC)
      IF(.CC.) 907,29,908
907  DISPLAY RC,REC
      CALL PRINTFILEINFO(IFL)
      STOP 72
908  CALL PRINTFILEINFO(IFL)
      STOP 74
29  TABLE(I,J,2)=RC
24  CONTINUE
25  CONTINUE
      GOTO 60
30  RC=RC+1
      TABLE(I,J,1)=RC
      GOTO 27
41  FIELD=ABS(DEPTH)
      IF(DP1.EQ.0.OR.DP2.EQ.0.OR.IRC.EQ.0) GOTO 24
      GOTO 28
42  FIELD=DST
      IF(LT1D.EQ.0.OR.LT2D.EQ.0) GOTO 24
      GOTO 28
43  FIELD=FLOATJ(ITM)
      IF(DRLY.EQ.0.OR.DRCY.EQ.0) GOTO 24
      GOTO 28
44  FIELD=GRTH
      IF(SZ1.EQ.0.OR.SZ2.EQ.0) GOTO 24
      IF(GRTH-GL)24,28,28
45  FIELD=FLOAT(SZ1)
      IF(SZ1.EQ.0.OR.IRC.EQ.0) GOTO 24
      GOTO 28
46  IF(DP1.EQ.0) GOTO 24
      FIELD=FLOAT(DP1)
      GOTO 28
47  IF(DP2.EQ.0.OR.IRC.EQ.0) GOTO 24

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FIELD=FLOAT(DP2)
GOTO 28
48 IF(SZ1.EQ.0) GOTO 24
FIELD=FLOAT(SZ1)
GOTO 28

C
C PRINT TABLE GIVING SUMMARY OF MALES, FEMALES, AND TOTALS FOR
C RELEASES, RECAPTURES, AND THE % OF RELEASES RECAPTURED.
C
500 WRITE(6,6002)
6002 FORMAT("1",34(" "),3X,"SUMMARY",3X,34(" "),/,1X,34(" "),
11X,"INFORMATION ",34(" "),/,/,14X,"TOTAL MALE FEMALE BERRIED",
22X,"ALL FEMALES"/)
TLFLB=RLF+RLB
WRITE(6,6003) RLT,RLM,RLF,RLB,TLFLB
6003 FORMAT(1X,"RELEASED ",5(15,2X),/)
RCFCB=RCF+RCB
WRITE(6,6004) RCT,RCM,RCF,RCB,RCFCB
6004 FORMAT(1X,"RECAPTURED ",5(15,2X),/)
IF(RLT.NE.0) RCPC=FLOATJ(RCT)/FLOATJ(RLT)*100.0
IF(RLM.NE.0) RCMPC=FLOATJ(RCM)/FLOATJ(RLM)*100.0
IF(RLF.NE.0) RCFPC=FLOATJ(RCF)/FLOATJ(RLF)*100.0
IF(RLB.NE.0) RCBPC=FLOATJ(RCB)/FLOATJ(RLB)*100.0
IF(TLFLB.NE.0) RCPPC=(FLOATJ(RCFCB)/FLOATJ(TLFLB))*100.0
WRITE(6,6005) RCPC,RCMPC,RCFPC,RCBPC,RCPPC
6005 FORMAT(1X,"RECAP % REL ",5(F6.2,1X),/)
LNS=68
DO 550 I=1,8
DO 520 K=1,5
IF(TABLE(K,I,1).NE.0) GOTO 530
520 CONTINUE
GOTO 550
530 CONTINUE

C
C PRINT SEVEN TABLES WITH EACH GIVING THE MEAN, S.E., S.D.,
C MIN., MAX., RANGE, NUM, AND SUM OF MALES, FEMALES, BERRIED, AND A
C TOTAL FOR DEPTH CHANGE, DISTANCE MOVED, DAYS RELEASED, GRTH AT
C RECAPTURE, REL.SIZE OF RECAPTURE, RELEASE DEPTH, RECAPTURE
C DEPTH, AND RELEASE SIZE.
C
IF(I.NE.2) GO TO 6070
WRITE(6,6067) ST2(I)
6067 FORMAT(/,1X,A14,7X,"MEAN",5X,"S.E.",5X,"S.D.",4X,
1"MIN MAX RANGE NUM SUM")
IF(OPT2-1) 6068,6069,6068
6069 WRITE(6,6066) ST4
GO TO 6080
6068 WRITE(6,6066) ST3
6066 FORMAT(1X,A14/)
GO TO 6080
6070 WRITE(6,6006) ST2(I)
6006 FORMAT(/,1X,A14,7X,"MEAN",5X,"S.E.",5X,"S.D.",4X,
1"MIN MAX RANGE NUM SUM"/)
6080 DO 540 J=1,5
RC=TABLE(J,I,1)
IF(RC.EQ.0) GOTO 540
C=0.0
TDATA=0.0
TD2=0.0
V(8)=99999999.0

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V(9)=-9999999.0
510 CALL FREADDIR(IFL,LR,6,RC)
    IF(.CC.) 900,511,900
511 READ(REC,1001) FIELD,RC
    C=C+1
    TDATA=TDATA+FIELD
    TD2=TD2+FIELD**2
    IF(FIELD.LT.V(8)) V(8)=FIELD
    IF(FIELD.GT.V(9)) V(9)=FIELD
    IF(RC.NE.0) GOTO 510
    V(2)=C
    V(1)=TDATA/C
    SSQ=TD2-TDATA**2/C
    IF(C.GT.1.0) V(3)=SSQ/(C-1.0)
    IF(C.LE.1.0) V(3)=0.0
    IF(V(3).NE.0.0) V(4)=SQRT(V(3))
    IF(V(3).EQ.0.0) V(4)=0.0
    V(5)=V(4)/SQRT(C)
    V(10)=V(9)-V(8)
    WRITE(6,6007) ST1(J),V(1),V(5),V(4),V(8),V(9),V(10),V(2),V(1)*V(2)
6007 FORMAT(1X,A8,11X,F6.1,2X,F7.1,2X,F7.1,1X,3(F6.1,1X),1X,F6.0,
    12X,F9.1,/)
540 CONTINUE
    LNS=LNS-13
    IF(LNS.GT.0) GOTO 550
    WRITE(6,6010)
6010 FORMAT("1")
    LNS=80
550 CONTINUE
    CALL FCLOSE(IFL,0,0)
    CALL FCLOSE(ILW,$11,0)
    STOP
    END
C
$CONTROL INIT,LIST
C    REAL FUNCTION SUBPROGRAM RDIFF1 TO CALCULATE THE DEGREE
C    CHANGE IN LATITUDE AND LONGITUDE AND DISTANCE TRAVELLED.
C
    REAL FUNCTION RDIFF1(LT1D,LT1M,LN1D,LN1M,LT2D,LT2M,LN2D,LN2M,DGS)
    DGS=0
    IF(LT1D.EQ.0.OR.LT2D.EQ.0) RDIFF1=0.0
    IF(LT1D.EQ.0.OR.LT2D.EQ.0) RETURN
C    CONVERT LATITUDE AND LONGITUDE FROM DEGREES TO MINUTES.
    ALT=FLOAT(LT1D*60+LT1M)
    ALN=FLOAT(LN1D*60+LN1M)
    BLT=FLOAT(LT2D*60+LT2M)
    BLN=FLOAT(LN2D*60+LN2M)
    DLAT=BLT-ALT
    DLON=COS(((ALT+BLT)/2.0)/60.0*(3.1415926/180.0))*(BLN-ALN)
C
C    DISTANCE TRAVELLED IN NAUTICAL MILES.
C
    RDIFF1=FLOAT(JFIX((SQRT(ABS(DLAT)**2+ABS(DLON)**2)+0.05)*10.0))
    1/10.0
    CON=180/3.1415927
    IF(ABS(DLON).EQ.0.AND.ABS(DLAT).EQ.0) GOTO 8
    IF(DLAT.EQ.0.AND.DLON.GT.0) GOTO 1
    IF(DLAT.EQ.0.AND.DLON.LT.0) GOTO 2
    IF(DLON.EQ.0.AND.DLAT.GT.0) GOTO 3
    IF(DLON.EQ.0.AND.DLAT.LT.0) GOTO 4

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      IF(DLAT.LT.0.AND.DLON.GT.0) GOTO 5
      IF(DLAT.GT.0.AND.DLON.GT.0) GOTO 6
      IF(DLAT.LT.0.AND.DLON.LT.0) GOTO 7
C
C      DEGREE CHANGE
C
      DGS=ATAN(ABS(DLON)/ABS(DLAT))*CON
      GOTO 8
1     DGS=270
      GOTO 8
2     DGS=90
      GOTO 8
3     DGS=360
      GOTO 8
4     DGS=180
      GOTO 8
5     DGS=ATAN(ABS(DLON)/ABS(DLAT))*CON+180
      GOTO 8
6     DGS=ATAN(ABS(DLAT)/ABS(DLON))*CON+270
      GOTO 8
7     DGS=ATAN(ABS(DLAT)/ABS(DLON))*CON+90
8     CONTINUE
      RETURN
      END
C
$CONTROL INIT,LIST
C      INTEGER FUNCTION SUBPROGRAM IDIFF2 TO CALCULATE THE NUMBER
C      OF DAYS OUT.
      INTEGER*4 FUNCTION IDIFF2(ID1,IM1,IY1,ID2,IM2,IY2)
      INTEGER MTHT(12)
      DATA MTHT/31,59,90,120,151,181,212,243,273,304,334,365/
      IDIFF2=1
      IF(IM1.LT.1.OR.IM1.GT.12.OR.IM2.LT.1.OR.IM2.GT.12) IDIFF2=0
      IF(IY1.EQ.0.OR.IY2.EQ.0) IDIFF2=0
      IF(IDIFF2.LT.1) RETURN
C      CONVERT YEARS INTO DAYS.
      YR1=FLOAT(IFIX(FLOAT(IY1-1)*365.25))
      YR2=FLOAT(IFIX(FLOAT(IY2-1)*365.25))
C      DETERMINE IF THE YEAR INVOLVED IS A LEAP YEAR.
      IF(IY1/4.EQ.FLOAT(IY1)/4.0.AND.IM1.GT.2) YR1=YR1+1
      IF(IY2/4.EQ.FLOAT(IY2)/4.0.AND.IM2.GT.2) YR2=YR2+1
C      SUM THE DAYS, MONTHS, AND YEAR TO EXPRESS THE DATE IN DAYS.
      YR1=YR1+ID1+MTHT(IM1)
      YR2=YR2+ID2+MTHT(IM2)
C      FIND IDIFF2 (DAYS OUT) BY SUBTRACTING THE DATES.
      IDIFF2=IFIX(YR2-YR1)
      RETURN
      END

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C
C SOURCE LISTING FOR PROGRAM STATLOC
C
C
C PROGRAM STATLOC
C
C SAVED AS QSTATLOC IN QEDIT
C COMPILED AS STATLOC
C MODIFIED TO ELIMINATE UNKNOWN VALUES JAN 20/83 G.FAWKES
C UNKNOWN OR INVALID VALUES FOR DEGREES,DAYS OUT AND DISTANCE
C ARE FLAGGED IN THE PROGRAM LOCSEL.
  CHARACTER TITLE*80,NAUT*12,KILO*12
  REAL DATA1,DATA4,TAG(3000),DAYS(3000),TIME,I
  REAL RSQT,ASQUARED,VEE,VEEPRIME,ARCVALUE,THETA,BEFOREARE
  REAL ARE,DATA2,DATA3,DIST(3000),DEG(3000),SINE,COSINE
  REAL RSINE,RCOSINE,ZED,CHI,PI,COUNT
  REAL MINMILES,MAXMILES,AVMILES,MINTIME,MAXTIME,AVTIME,MILES
  REAL MILES2,TMILES2,SDMILE1,SDMILE,SDMILE2,SEMILE,RANGMILE
  REAL TIME2,TTIME2,SDTIME1,SDTIME,SDTIME2,SETIME,RANGTIME
  INTEGER OPT2
  ON REAL DIV 0 CALL DVZR
  ON REAL UNDERFLOW CALL UNDR
  I=0.0
  PI=22.0/7.0
  READ(5,11)TITLE
11  FORMAT(A80)
2   CONTINUE
  READ(2,100,END=10)DATA1,DATA2,DATA3,DATA4,OPT2
100  FORMAT(I5,2X,F5.1,2X,F5.1,2X,I4,2X,I2)
  IF(DATA2.EQ.0.AND.DATA3.EQ.0.AND.DATA4.EQ.0) GO TO 2
  IF (DATA2.EQ.999.OR.DATA3.EQ.999.OR.DATA4.EQ.-99)GO TO 2
  I=I+1.0
C TAG NO
  TAG(I)=DATA1
C STRAIGHT LINE DISTANCE TRAVELLED(KM. OR NAUT. MILES
C BETWEEN RELEASE AND RECAPTURE.
  DIST(I)=DATA2
C DIRECTION MOVED DEGREES FROM TRUE NORTH.
  DEG(I)=DATA3
C DAYS OUT BETWEEN RELEASE AND RECAPTURE.
  DAYS(I)=DATA4
  GO TO 2
10  TIME=0.0
  TIME2=0.0
  MILES2=0.0
  MILES=0.0
  SINE=0.0
  COSINE=0.0
  RSINE=0.0
  RCOSINE=0.0
  RSQT=0.0
  TIM=0
  NAUT="(NAUT. MILES"
  KILO="(KILOMETERS "
  MINMILES=5000.0
  MAXMILES=0.0
  MINTIME=5000.0
  MAXTIME=0.0
  DO 20 J=1,I

```

```

MILES2=MILES2+DIST(J)**2
MILES=MILES+DIST(J)
IF(DIST(J).GT.MAXMILES) MAXMILES=DIST(J)
IF(DIST(J).LT.MINMILES) MINMILES=DIST(J)
TIME=TIME+DAYS(J)
TIME2=TIME2+DAYS(J)**2
IF(DAYS(J).GT.MAXTIME) MAXTIME=DAYS(J)
IF(DAYS(J).LT.MINTIME) MINTIME=DAYS(J)
DEG(J)=DEG(J)*PI/180.0
SINE=SINE+SIN(DEG(J))
COSINE=COSINE+COS(DEG(J))
RSINE=RSINE+DIST(J)*SIN(DEG(J))
RCOSINE=RCOSINE+DIST(J)*COS(DEG(J))
RSQT=RSQT+DIST(J)**2/DAYS(J)
TIM=TIM+DAYS(J)
20 CONTINUE
TMILES2=MILES2**2
TTIME2=TIME**2
SDTIME1=TIME2-(TTIME2/I)
SDMILE1=MILES2-(TMILES2/I)
IF(I.GT.1.0)SDTIME2=SDTIME1/(I-1.0)
IF(I.LE.1.0)SDTIME2=0.0
IF(I.LE.1.0)SDMILE2=0.0
IF(I.GT.1.0)SDMILE2=SDMILE1/(I-1.0)
IF(I.GT.1.0)SDTIME=SQRT(SDTIME2)
IF(I.LE.1.0)SDTIME=0.0
IF(I.GT.1.0)SDMILE=SQRT(SDMILE2)
IF(I.LE.1.0)SDMILE=0.0
SETIME=SDTIME/SQRT(I)
SEMILE=SDMILE/SQRT(I)
RANGTIME=MAXTIME-MINTIME
RANGMILE=MAXMILES-MINMILES
AVTIME=TIME/I
AVMILES=MILES/I
ASQUARED=(RSQT-RCOSINE**2/TIM)/I
VEE=RCOSINE/TIM
VEEPRIME=RSINE/TIM
ARCVALUE=RSINE/RCOSINE
OLDTHETA=ATAN(ARCVALUE)
THETA=OLDTHETA*180.0/PI
BEFORARE=SINE**2+COSINE**2
ARE=SQRT(BEFORARE)
ZED=ARE**2/I
IF(VEE.GE.0.AND.VEEPRIME.GE.0) GO TO 205
IF(VEE.LT.0.AND.VEEPRIME.GE.0) THETA=THETA+180.0
IF(VEE.GE.0.AND.VEEPRIME.LT.0) THETA=THETA+360.0
IF(VEE.LT.0.AND.VEEPRIME.LT.0) THETA=THETA+180.0
205 WRITE(6,108)TITLE
WRITE(6,109)
WRITE(6,110)I,TIME,MINTIME,MAXTIME,RANGTIME
WRITE(6,112)AVTIME,SDTIME,SETIME
WRITE(6,111)
WRITE(6,110)I,MILES,MINMILES,MAXMILES,RANGMILE
WRITE(6,112)AVMILES,SDMILE,SEMILE
IF(OPT2.EQ.1) GO TO 200
WRITE(6,101) NAUT,ASQUARED
WRITE(6,102) NAUT,VEE
WRITE(6,103) NAUT,VEEPRIME
GO TO 201
200 WRITE(6,101) KILO,ASQUARED

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        WRITE(6,102) KILO,VEE
        WRITE(6,103) KILO,VEEPRIME
201  WRITE(6,104)THETA
        WRITE(6,105)ARE
        WRITE(6,106)ZED
101  FORMAT(1X,"MEAN SQUARE DISPERSION COEFFICIENT ",A12,"**2/DAY)",
12X,3("  "),F11.5)
102  FORMAT(1X,"NORTH-SOUTH DIRECTIONAL COMPONENT ",A12," /DAY)",
12X,4("  "),F11.5)
103  FORMAT(1X,"EAST-WEST DIRECTIONAL COMPONENT ",A12," /DAY)",
11X,5("  "),F11.5)
104  FORMAT(1X,"MEAN VECTOR ANGLE",1X,16("  "),F11.5)
105  FORMAT(1X,"RAYLEIGH TEST",2X,17("  "),F11.5)
106  FORMAT(1X,"RAYLEIGH TEST STATISTICS (R**2/N)",11("  "),F11.5)
108  FORMAT(1X,A80,/)
109  FORMAT(9X,"*****STATISTICAL INFORMATION FOR DAYS OUT*****")
111  FORMAT(9X,"*****STATISTICAL INFORMATION FOR DISTANCE MOVED*****")
110  FORMAT(/,11X,"NUMBER OF INDIVIDUALS",6("  "),F8.2,
1/,11X,"SUM",11("  "),".",F10.2,
2/,11X,"MINIMUM",2X,10("  "),F8.2,
3/,11X,"MAXIMUM",2X,10("  "),F8.2,
4/,11X,"RANGE",1X,11("  "),F8.2)
112  FORMAT(11X,"MEAN",2X,11("  "),F8.2,
1/,11X,"STANDARD DEVIATION",7("  "),F8.2,
2/,11X,"STANDARD ERROR",1X,8("  "),F8.2,/)
        STOP
        END
C
        SUBROUTINE UNDR(RL)
        RL=0
        RETURN
        END
C
        SUBROUTINE DVZR(RR)
        RR=0
        RETURN
        END

```

EXAMPLE OF INPUT TO LOCSEL

00867110087744426639	150480	11	2	053
02253123117744476640	31704804439663711	1	11	053090
0226912311774447664011831904804138682711		1	11	3 053105
0025411207774442663914032104804439663711		2	11	1652 053090
0043712007774441664116010505804439663711			11	1861 018090
0100711508774447664013230505804439663711		2	11	1552 053100
0148310309774441664111030505804439663711		3	11	1452 018100
0041212007774442663912820605804439663711			11	1433 053090
0026211207774442663914511505804321663011			11	053075
0051412307774445664512511505804506663311			11	018018
0057612307774447664014511505804351692911			11	053
0234512511774447664012031505804507661811		1	11	053020
0091611008774441664113021905804437664411			11	1443 018090
0088411008774442663914532105804439663711		2	11	1572 053090
0011811207774445664513022605804437664411			11	1473 018090
0019211207774447664013513105804503662811			11	1711 053020
0096711008774447664013011006804437664411			11	1581 053090
0219112111774442663910531106804439663711		1	11	1273 053070
0038612007774442663910021206804437664411			11	1193 053090
0097911008774447664009021206804437664411			11	053
0056012307774447664014211606804503662811			11	1741 053018
0033211607774441664121806804444664311			11	1392 018045
0036511607774447664013511806804439663711			11	1641 053090
0070012707774445664511511806804444664311			11	1381 018055
0211611811774445664511531806804441664111		1	11	1343 018040
0229312511774442663931806804439663711		1	11	053070
0024811207774442663910532306804439663711		2	11	1342 053090
0070912707774445664511012306804441664111			11	1411 018045
0158210609774445664511022306804437664411			11	1222 018070
0241612811774447664032306804441664111		1	11	1313 053040
0085811008774442663912406804439663711			11	1831 053090
0393013107784447664011830104814439663711		2	11	1402 053090
0380512807784447664015311204814439663711			11	053
0379412807784447664014821504814438663511			11	053095
0395613107784445664516312504814243704411			13	1881 018
0524512508784447664012231105814439663711		3	11	053070
0391313107784447664014410106814140695411			11	053
0480011508784447664016330306814439663711		2	11	1842 053090
0636912209784445664511531106814439663711		3	11	1212 018090
0395213107784445664511821506814439663711			11	018085
051271230878443866540882150681			2	018

EXAMPLE OF OUTPUT FROM LOCSEL

AREA A 1977-78 RELEASES

TAG #	DATE RELEASED	REL LAT	REL LONG	REL REL DEP	REL REL S/E	DATE RECAPTURED	REC LAT	REC LONG	REC REC DEP	REC REC S/E	ORTH NM	ORTH \$	DEP CINO	DIST MOVD KM.	TRUE DIRC	DAYS OUT	T F G CODES
700	77/ 7/27	4445 6645	18 115	1		80/ 6/18	4444 6643	55 138	1	23.	20.00		37.	3.2	125.1	1056	1 1 1 0/081
254	77/ 7/12	4442 6639	53 140	3	2	80/ 4/21	4439 6637	90 165	2	25.	17.86		37.	6.1	154.6	1013	1 1 1 0/081
412	77/ 7/20	4442 6639	53 128	2		80/ 5/ 6	4439 6637	90 143	3	15.	11.72		37.	6.1	154.6	1021	1 1 1 0/081
884	77/ 8/10	4442 6639	53 185	3	2	80/ 5/21	4439 6637	70 127	3	22.	8.28		37.	6.1	154.6	1015	1 1 1 0/081
2191	77/11/21	4442 6639	53 105	3	1	80/ 6/11	4439 6637	90 134	2	29.	20.95		17.	6.1	154.6	933	1 1 1 0/081
248	77/ 7/12	4442 6639	53 105	3	2	80/ 6/23	4439 6637	90 186	1	26.	27.62		37.	6.1	154.6	1076	1 1 1 0/081
437	77/ 7/20	4441 6641	18 160	1		80/ 5/ 5	4439 6637	100 145	2	35.	16.25		72.	6.5	125.1	1020	1 1 1 0/081
1483	77/ 9/ 3	4441 6641	18 110	3	3	80/ 5/ 5	4439 6637	100 145	2	35.	31.82		82.	6.5	125.1	976	1 1 1 0/081
916	77/ 8/10	4441 6641	18 130	2		80/ 6/18	4441 6641	40 134	3	14.	10.72		72.	8.3	208.1	1013	1 1 1 0/081
2116	77/11/18	4445 6645	18 115	3	1	80/ 6/23	4441 6641	45 141	1	31.	28.18		22.	9.1	144.6	943	1 1 1 0/081
709	77/ 7/27	4445 6645	18 110	1		80/ 6/23	4437 6644	90 119	3	19.	19.00		37.	11.3	215.4	1057	1 1 1 0/081
306	77/ 7/20	4442 6639	53 100	2		80/ 6/12	4437 6644	90 147	3	17.	13.08		72.	14.8	174.9	1049	1 1 1 0/081
118	77/ 7/12	4445 6645	18 130	2		80/ 5/26	4437 6644	90 147	3	17.	10.91		52.	14.8	174.9	1021	1 1 1 0/081
1582	77/ 9/ 6	4445 6645	18 110	2		80/ 6/23	4437 6644	70 122	2	12.	13.08		47.	15.4	165.1	994	1 1 1 0/081
1007	77/ 8/15	4447 6640	53 132	3	2	80/ 5/ 5	4439 6637	100 155	2	23.	21.48		37.	15.4	165.1	1067	1 1 1 0/081
365	77/ 7/16	4447 6640	53 135	1		80/ 6/18	4439 6637	90 164	1	29.	17.48		37.	15.4	165.1	988	1 1 1 0/081
3930	78/ 7/31	4447 6640	53 118	3	2	81/ 4/ 1	4439 6637	0	0	0-153--100.00		-53.	15.4	165.1	990	1 1 1 0/081	
3805	78/ 7/28	4447 6640	53 153	1		81/ 4/12	4439 6637	70	0	0-122--100.00		17.	15.4	165.1	1022	1 1 1 0/081	
5245	78/ 8/25	4447 6640	53 122	3	3	81/ 5/11	4439 6637	90 184	2	21.	12.88		37.	15.4	165.1	990	1 1 1 0/081
4800	78/ 8/15	4447 6640	53 163	3	2	81/ 6/ 3	4439 6637	90 121	2	6.	5.22		72.	15.4	136.5	993	1 1 1 0/081
6369	78/ 9/22	4445 6645	18 115	3	3	81/ 6/11	4439 6637	90 158	1	28.	21.54		37.	19.3	195.9	1034	1 1 1 0/081
3952	78/ 7/28	4445 6645	18 118	2		81/ 6/15	4439 6637	85	0	0-118--100.00		67.	15.4	136.5	1049	1 1 1 0/081	
3794	78/ 7/28	4447 6640	53 148	2		81/ 4/15	4438 6635	90 158	1	28.	21.54		37.	19.3	195.9	991	1 1 1 0/081
967	77/ 8/10	4447 6640	53 130	1		80/ 6/10	4437 6644	90 158	1	36.	26.67		33.	33.5	28.0	1054	1 1 1 0/081
192	77/ 7/12	4447 6640	53 135	1		80/ 5/31	45 3 6628	20 171	1	32.	22.54		-35.	33.5	28.0	1056	1 1 1 0/081
560	77/ 7/23	4447 6640	53 142	1		80/ 6/16	45 3 6628	18 174	1	0-125--100.00		0.	42.1	22.0	1027	1 1 1 0/081	
2345	77/11/25	4447 6640	53 125	1		80/ 5/15	45 6 6633	18	0	0-120--100.00		-33.	16.9	37.9	903	1 1 1 0/081	
262	77/ 7/12	4442 6639	53 185	1		80/ 5/15	4321 6630	75	0	0-145--100.00		22.	150.7	175.4	1038	1 1 1 0/081	
576	77/ 7/23	4447 6640	53 145	1		80/ 5/15	4351 6929	0	0	0-145--100.00		-53.	247.0	245.1	1027	1 1 1 0/081	
2269	77/11/23	4447 6640	53 118	3	1	80/ 4/19	4138 6827	105	0	3-118--100.00		52.	379.0	202.4	878	1 1 1 0/081	
3956	78/ 7/31	4445 6645	18 163	1		81/ 4/25	4243 7044	0 188	1	25.	15.34		-18.	331.8	234.8	998	1 1 1 0/081
3913	78/ 7/31	4447 6640	53 144	1		81/ 6/ 1	4140 6954	0	0	0-144--100.00		-53.	434.4	217.1	1035	1 1 1 0/081	

EXAMPLE OF LOCSEL OUTPUT (CONTINUED)

SUMMARY INFORMATION									
	TOTAL	MALE	FEMALE	BERRIED	ALL FEMALES				
RELEASED	33	13	7	13	20				
RECAPTURED	33	13	11	9	20				
RECAP % REL	100.00	100.00	157.14	69.23	100.00				
DEPTH CHANGE	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM	
MALE	33.3	6.3	18.8	.0	72.0	72.0	9.	300.0	
FEMALE	54.1	6.1	16.0	37.0	72.0	35.0	7.	379.0	
BERRIED	40.5	5.3	19.3	17.0	82.0	65.0	13.	527.0	
TOTAL	41.6	3.6	19.4	.0	82.0	82.0	29.	1206.0	
TOT FEM	45.3	4.2	19.0	17.0	82.0	65.0	20.	906.0	
DISTANCE MOVED (KILOMETERS)	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM	
MALE	107.8	42.3	152.7	3.2	434.4	431.2	13.	1401.9	
FEMALE	12.7	1.6	4.3	6.1	18.0	11.9	7.	88.7	
BERRIED	41.8	28.3	101.9	6.1	379.0	372.9	13.	542.9	
TOTAL	61.6	20.7	119.1	3.2	434.4	431.2	33.	2033.5	
TOT FEM	31.6	18.4	82.3	6.1	379.0	372.9	20.	631.6	
DAYS RELEASED	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM	
MALE	1035.6	6.7	24.1	988.0	1067.0	79.0	13.	13463.0	
FEMALE	1028.7	9.0	23.8	991.0	1057.0	66.0	7.	7201.0	
BERRIED	977.7	14.7	53.0	878.0	1076.0	198.0	13.	12710.0	
TOTAL	1011.3	8.1	46.3	878.0	1076.0	198.0	33.	33374.0	
TOT FEM	995.6	11.3	50.7	878.0	1076.0	198.0	20.	19911.0	
GRTH AT RECAP	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM	
MALE	28.8	1.5	4.2	23.0	36.0	13.0	8.	230.0	
FEMALE	15.4	1.2	2.7	12.0	19.0	7.0	5.	77.0	
BERRIED	21.4	2.6	8.1	6.0	35.0	29.0	10.	214.0	
TOTAL	22.7	1.6	7.7	6.0	36.0	30.0	23.	521.0	
TOT FEM	19.4	1.9	7.3	6.0	35.0	29.0	15.	291.0	

EXAMPLE OF LOCSEL OUTPUT (CONTINUED)

REL. SIZE OF REC	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	138.6	4.4	15.9	110.0	163.0	53.0	13.	1802.0
FEMALE	123.4	5.9	15.7	100.0	148.0	48.0	7.	864.0
BERRIED	123.7	4.7	17.0	105.0	163.0	58.0	13.	1608.0
TOTAL	129.5	3.0	17.4	100.0	163.0	63.0	33.	4274.0
TOT FEM	123.6	3.6	16.1	100.0	163.0	63.0	20.	2472.0

RELEASE DEPTH	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	39.5	4.9	17.7	18.0	53.0	35.0	13.	514.0
FEMALE	33.0	7.1	18.7	18.0	53.0	35.0	7.	231.0
BERRIED	44.9	4.3	15.3	18.0	53.0	35.0	13.	584.0
TOTAL	40.3	3.0	17.1	18.0	53.0	35.0	33.	1329.0
TOT FEM	40.8	3.8	17.1	18.0	53.0	35.0	20.	815.0

RECAPTURE DEP.	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	55.7	10.6	31.9	18.0	90.0	72.0	9.	501.0
FEMALE	87.1	3.1	8.1	70.0	95.0	25.0	7.	610.0
BERRIED	80.4	6.9	24.9	20.0	105.0	85.0	13.	1045.0
TOTAL	74.3	5.1	27.2	18.0	105.0	87.0	29.	2156.0
TOT FEM	82.8	4.6	20.6	20.0	105.0	85.0	20.	1655.0

RELEASE SIZE	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	138.6	4.4	15.9	110.0	163.0	53.0	13.	1802.0
FEMALE	123.4	5.9	15.7	100.0	148.0	48.0	7.	864.0
BERRIED	123.7	4.7	17.0	105.0	163.0	58.0	13.	1608.0
TOTAL	129.5	3.0	17.4	100.0	163.0	63.0	33.	4274.0
TOT FEM	123.6	3.6	16.1	100.0	163.0	63.0	20.	2472.0

EXAMPLE OF OUTPUT FROM STATLOC

*****STATISTICAL INFORMATION FOR DAYS OUT*****

NUMBER OF INDIVIDUALS.	33.00
SUM.	33374.00
MINIMUM	878.00
MAXIMUM	1076.00
RANGE	198.00
MEAN	1011.33
STANDARD DEVIATION.	46.28
STANDARD ERROR	8.06

*****STATISTICAL INFORMATION FOR DISTANCE MOVED*****

NUMBER OF INDIVIDUALS.	33.00
SUM.	2033.50
MINIMUM	3.20
MAXIMUM	434.40
RANGE	431.20
MEAN	61.62
STANDARD DEVIATION.	119.13
STANDARD ERROR	20.74

MEAN SQUARE DISPERSION COEFFICIENT (KILOMETERS **2/DAY)	16.40784
NORTH-SOUTH DIRECTIONAL COMPONENT (KILOMETERS /DAY)	-.03850
EAST-WEST DIRECTIONAL COMPONENT (KILOMETERS /DAY)	-.02365
MEAN VECTOR ANGLE	211.54541
RAYLEIGH TEST	22.13327
RAYLEIGH TEST STATISTICS (R**2/N).	14.84489

